Cat. No. S103-E1-01

KP_G-OD-_
KP_L-OD-_

Grid Connect Photovoltaic Inverter

COMMUNICATION MANUAL

OMRON

1

Introduction

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1-1 Introduction

Thank you for choosing the KP□□G or KP□□L (hereafter described KP inverter) Grid Connect Photovoltaic Inverter. This communication manual describes essential information regarding communication of the KP inverter.
The KP inverter is designed for use in Grid Connect Solar Systems. The installation must always be carried out by qualified personnel with knowledge of electrical systems and according to national standards for electrical installations.

- This communication manual is intended for Users and Installers of the KP inverter.
- Read this manual carefully and make sure that you understand it well to ensure that you are using the communication of KP inverter.
- Keep this manual in a safe location so that it is available for reference when required.
- For detail description such as function, performance, and usage of the KP inverter, refers to the manual of the KP inverter.

1-2 Read and Understand This Manual

Read and understand this manual before using the KP inverter. Please consult your OMRON representative if you have any questions or comments.

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Settings

This section describes the settings of communications by the KP inverter.

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2-1 Outline of communications functions

The KP inverter are equipped with an RS232C/RS-485 port, which allows remote monitoring and remote operations over networks.

The following protocol is supported:

Model	Suported protocol
KP□□G	Compoway/F
KP□□L	Compoway/F, MODBUS

The KP inverter has the following communications functions:
Reading settings and data
Executing operation commands

CompoWay/F is OMRON's unified communications protocol for general-purpose serial communications. This unified format has a proven track record with OMRON Programmable Controllers, has FINS-compliant commands (see note), and simplifies communications between the host computer and components.
Note:
FINS (Factory Interface Network service) is a messaging protocol for communications between Controllers in OMRON FA networks.

Modbus is a standard communications control method that conforms to the Modicon Company’s RTU-mode Modbus Protocol (PI-MBUS-300 Revision J).
Supports functions are similar to the CompoWay/F Read Variable Area, Write Variable Area, Operation Command.

2-2 Cable Connections

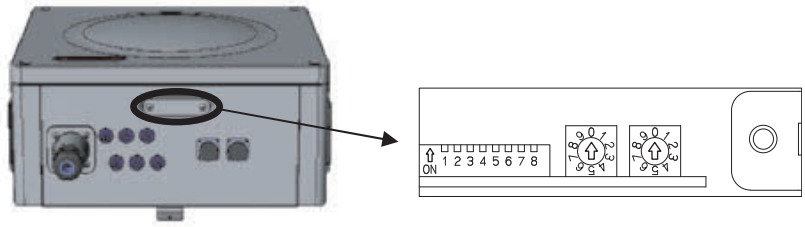
Refer the manual of each inverter for cable connections.

2-3 Communications settings

2-3-1 Communication settings for KP40G

Communication protocol settings
You can use only Compoway/F on KP40G.
There is no setting for communication protocol.

Node number (Unit number) settings
Node number can be set by setting switch as shown figure.

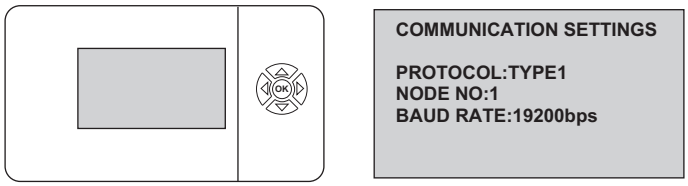


Baud rate settings
Baud rate is fixed 19200bps.

2-3-2 Communication settings for KP100G

Communication protocol settings
You can use only Compoway/F on KP100G.
Always set TYPE1 as protocol on communication settings menu of Data Logger.

Node number (Unit number) and baud rate settings
Node number and baud rate can be set by menu of communication settings on Data Logger of the inverter.



[Setting procedure]

1 Use ▲/▼ to select COMMUNICATION SETTINGS.

2 Press "OK" to set.

3 Use ▲/▼ to select item which you set

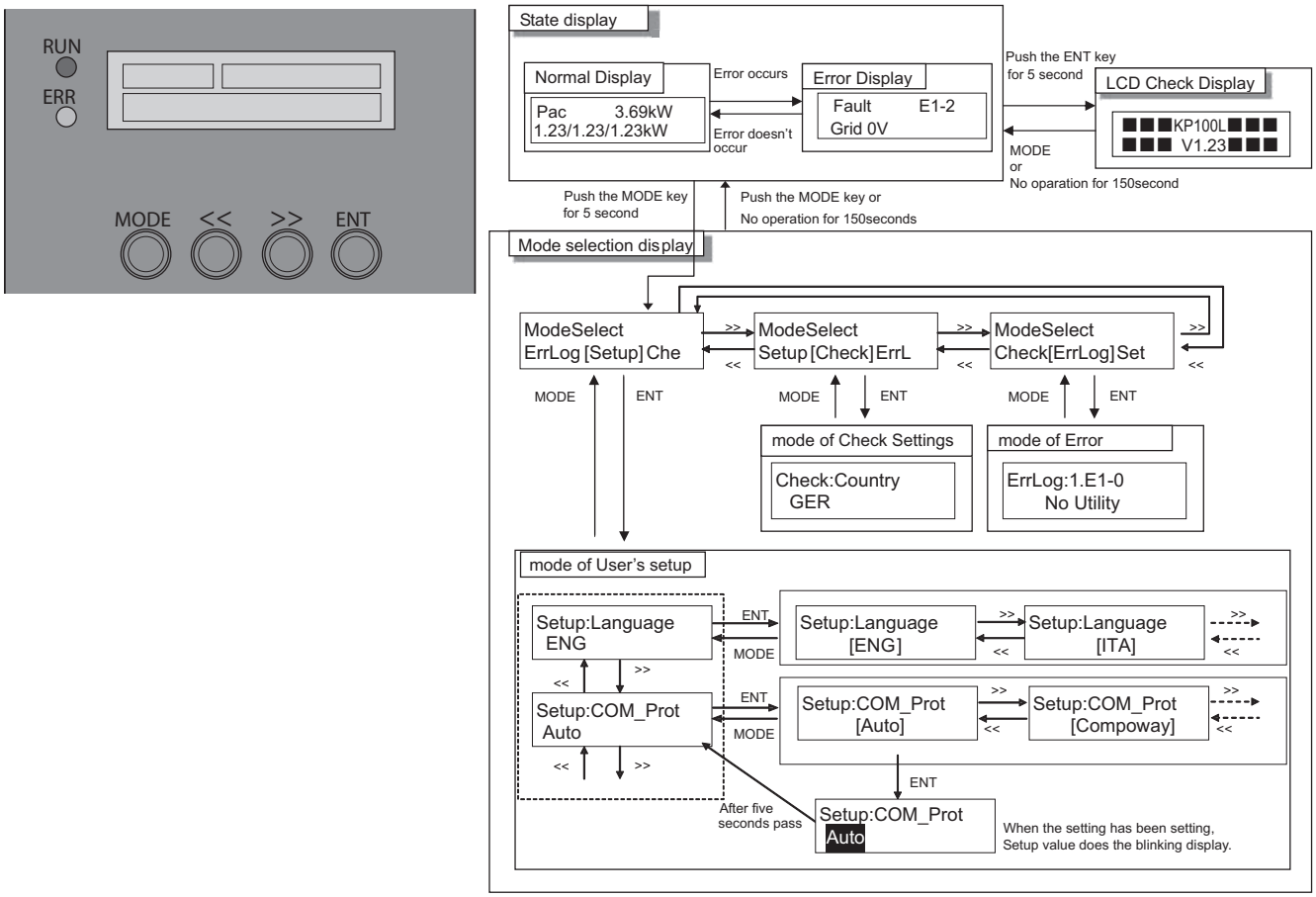
4 Use ◀/▶ to set node number and baud rate..

5 Press "OK" again to confirm.

2-3-3 Communication settings for KP□□L

Communication protocol settings

Select Compoway/F or MODBUS on KP□□L by LCD menu.



Node number (Unit number) and baud rate settings

Select communication protocol and set node number and baud rate by LCD menu.

[Setting procedure]

1 Push the MODE key for 5 second, and enter Mode Selection Display.

2 Push <</>> to select “Setup".

3 Push ENT key and enter mode of User’s setup.

<Protocol>

4 Select “Setup:Protocol” and .push ENT key.

5 User <</>> to change protocol. If you select “Auto”, protocol is detected automatically according to communication command.

<Node number>

4 Select “Setup:COM_Unit” and .push ENT key.

5 User <</>> to change number.

<Baud rate>

4 Select “Setup: COM_232C” or “Setup: COM_485”, and .push ENT key.

5 User <</>> to change baud rate.

6 Push MODE key to confirm communication protocol

7 Push MODE key to rerun normal display.

Refer the user’s manual of KP□□L for more detail information.

3

Compoway/F

This section describes how to use Compoway/F communications based on communications commands.

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3-1 CompoWay/F Communications Specifications

Communications Control Method

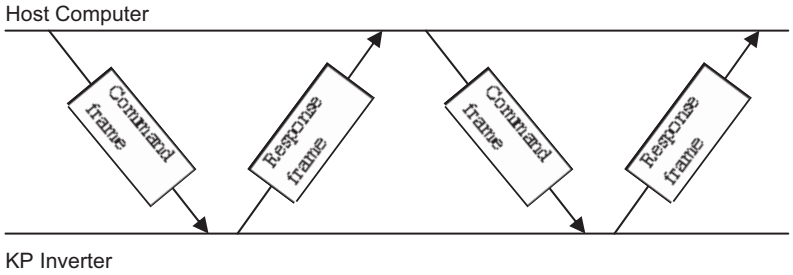
Programs can be created in the host computer (e.g., a personal computer) toset or monitor parameters in theKP inverter. Therefore the descriptions in this section are from the standpoint of the host computer. For example, "Read/Write" refers to the host computer reading or writing to the inverter.

Communications Specifications

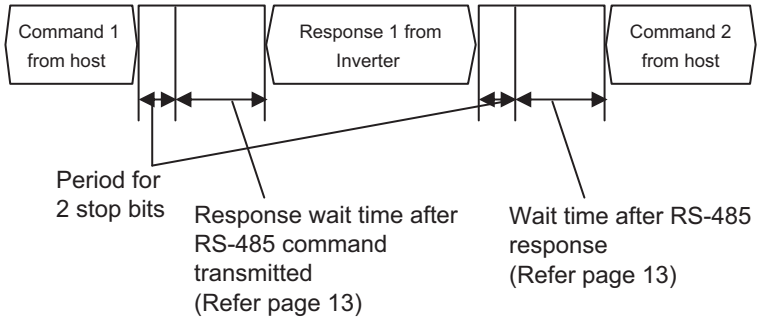
Interface	RS-485	RS-232C
Transmission path connections	Multipoint	Single point
Communications	2-wire system half duplex	Half duplex
Synchronization	Start-stopsynchronization	
Baud rate *: default	KP40G 19200bps KP100G 9600 / *19200bps KP□□L 4800 / 9600 / *19200bps	KP40G 9600bps KP100G 9600 / *19200bps KP□□L 4800 / *9600 / 19200bps
Transmitted code	ASCII	
Data bit length	7 bits	
Stop bit length	2 bits	
Error detection	Vertical parity (even) BCC (block check character)	
Data transmission	LSB first	
Flow control	None	
Retry function	None	
Communications buffer	KP40G / KP□□L 280 reception buffer bytes 273 transmission buffer bytes KP100G 424 reception buffer bytes 417 transmission buffer bytes	
Response wait time after RS-485 command transmitted	KP40G : 0.5 ms or more KP100G : 1.0 ms or more e KP□□L : 0 to 99 ms (adjustable) (Prohibit time from when command is sent from host to when response is sent from inverter.	
Waiting time after RS-485 response	5.0 ms or more (Prohibit time for command transmission after response received from inverter)	
The next command waiting time after simultaneous broadcasting	30ms or more	

3-2 Frame Formats

The host computer sends a command frame, and the KP inverter sends a response frame based on the content of the command frame. One response frame is sent in response to one command frame.



After a receiving a response from the inverter, have the host computer wait specified waiting time at least before sending the next command as shown the figure.

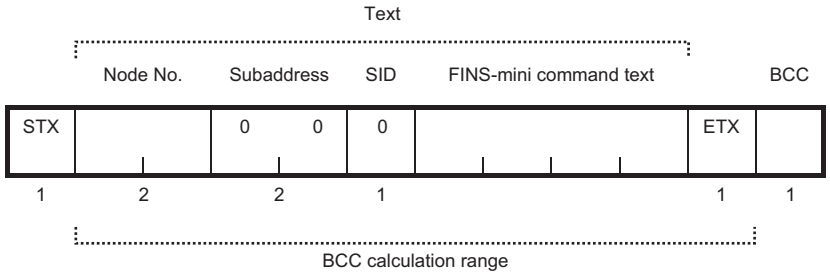

Command 1 from host
Response 1 from Inverter
Command 2 from host
Period for 2 stop bits
Response wait time after RS-485 command transmitted (Refer page 13)
Wait time after RS-485 response (Refer page 13)

3-2-1 Command Frame structure

Based on CompoWay/F protocol, commands from the host computer and responses from the KP inverter take the form of frames.

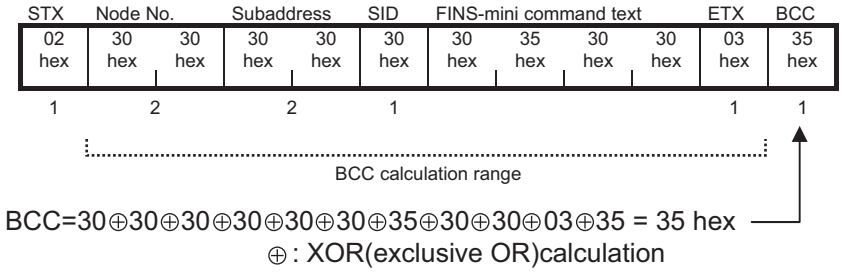
The data comprising command frames and response frames are explained below.

In the following explanation, an "hex" following a numeric value (for example 02 hex) indicates that the value is a hexadecimal number. A number or letters enclosed in quotation marks (for example "00") is an ASCII character.



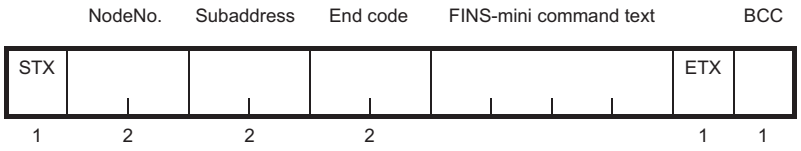
STX	This code, 02 hex, indicates the beginning of a communications frame (text). This code must always be set as the first byte. When another STX code is received during reception, the reception starts again from the point where the STX was received.
Node No.	The node address identifies the destination node. • The node address can be set to "00" to "99". If you use communication by multiple inverters, set the node address "01" to "31". • There will be no response to a transmission with an invalid node address.
Subaddress	Not used in the KP inverter. Always set the subaddress to “00”.
SID (Service ID)	Not used in the KP inverter. Always set the SID to “00”.
FINS-mini command and text	The command and required text are placed here. Refer to *3-3 FINS-mini* for details.
ETX	This code, 03 hex, indicates the end of text.
BCC	This is the block check character. The BCC is calculated by taking the exclusive OR of all bytes from the node number to the ETX.

BCC Calculation Example



Note No response will be returned unless the frame contains all elements up to the ETX and BCC

3-2-2 Response Frame Structure



End code	Neme	Meaning	Error priority
00	Normal end	The command frame was processed normally without any of the following errors.	None
0F	FINS command error	The specified FINS command could not be executed. Refer to the response code for more details.	8
11	Framing error	The stop bit is “0”.	1
12	Overrun error	Attempted to write new data to the reception register when the reception register was full.	3
13	BCC error	The received BCC did not match the calculated BCC.	5
14	Format error	There was an illegal character in the FINS-mini frame (character other than ASCII 0 to 9 or A to F) or data other than the test data was returned in response to an Echoback Test. There were no SID and FINS-mini. There was no FINS-mini. The FINS-mini MRC and SRC were incorrect.	7
16	Subaddress error	The subaddress was invalid (unsupported). There were no subaddress, SID, and FINS-mini. The subaddress was shorter than 2 characters and there were no SID and FINS-mini.	6
18	Frame length error	The received frame exceeds the specified number of bytes.	4

- An end code is returned for each received command frame addressed to the local node.
- No response will be returned if the message is not complete through the ETX and BCC characters.
- The error priority indicates the priority of the error notification when there were two or more errors.
- The FINS-mini command and text section is not included for end codes other than 00 and 0F.

3-3 FINS-mini

The FINS-mini command text and response text provides the contents of the command and response communications.

3-3-1 PDU Formats

Command Text

The MRC (Main Request Code), SRC (Sub-Request Code), and any required data are transmitted in the command frame.

- **Service Request PDU**

Response Text

The MRC and SRC shown above, MRES (Main Response Code), SRES (Sub-Response Code), and the response data are transmitted in the response frame.

- **Service Response PDU (Normal Response)**

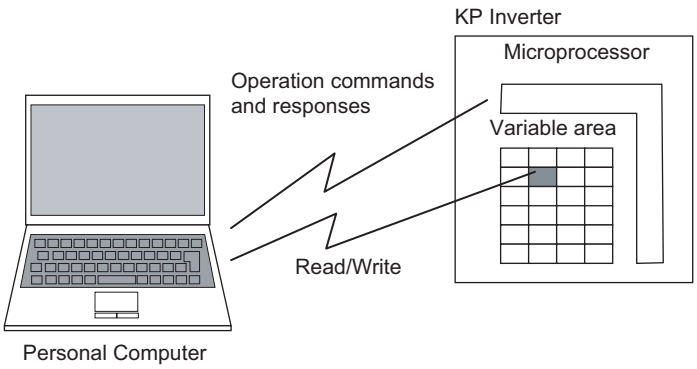
If the specified FINS-mini command could not be executed, service response PDU will contain only the MRC/SRC and MRES/SRES.

- **Service Response PDU (Specified FINS-mini Command Not Executed)**

The MRES and SRES become the response code when the command was not completed normally.

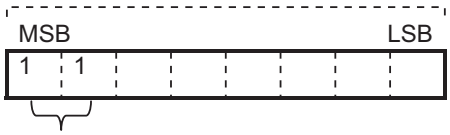
3-3-2 Variable Areas

The area used for data exchange when communicating with the KP inverter is called the "variable area." The current values are read and various setting data are read and written using the variable area of the KP inverter. Operation commands and Read Controller Attributes do not use the variable area.



3-3-3 Type code (variable type)

The definition of the type code of the variable area does as follows.
For more information, refer to *5-1 Variable Area (Setting Range) List*.



Access size
01:Byte
10:Word
11:Doubleword

Variable type	Support			R/W	Size	Contents
	KP40G	KP100G	KP□□L			
47	x	x	x	R/W	Byte	Set Value for setting country
48		x	x	R	Byte	DC input information
C1	x	x	x	R/W	Double word	Set value for protective relay
C2	x	x	x	R	Double word	Standard Measurement
C3	x	x	x	R	Double word	Standard instruction data
C8		x	x	R	Double word	Three Phase Measurement
CA	x	x	x	R	Double word	Data for PV/grid information
D0	x	x	x	R	Double word	Error logging

3-3-4 Address

Refer to *5-1 Variable Area (Setting Range) List*.

3-3-5 Number of elements

The number of elements is expressed in 2-byte hexadecimal format.
The range for specifying the number of elements differs for each command.
Refer to *3-4 Detailed Description of Services*.

3-3-6 List of Services

MRC	SRC	Support			Service name	Processing
		KP40G	KP100G	KP□□L		
01	01	x	x	x	Read from variable area	Reads value from variable areas.
01	04			x	Composite read from variable area	Reads composite values from variable areas.
05	01	x	x	x	Read Controller information	Reads the model and version.
05	03	x	x	x	Read Controller Attributes	Reads the model number and communications buffer size.
06	01	x	x	x	Read Controller Status	Reads the operating status.
08	01	x	x	x	Echoback Test	Performs an echoback test
30	05	x	x	x	Operation Command	Performs following operations. - Initialize Error log - Clear the amount of energy for period user set
41	01	x	x	x	Read character string area.	Reads the character string area.

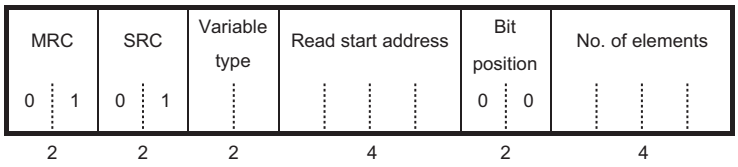
3-4 Detailed Description of Services

3-4-1 Read from variable area

This service reads data from a variable area.

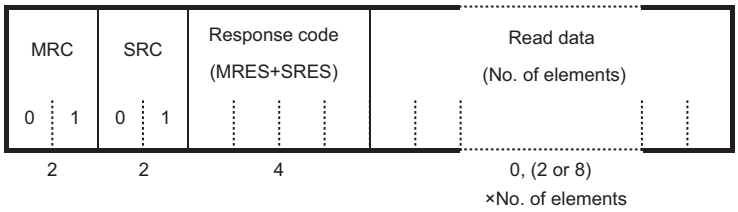
Command

- **Service Request PDU**



Response

- **Service Response PDU**



(1) Variable Type and Read Start Address

Refer to *5-1 Variable Area (Setting Range) List*.

If data outside the address range is read, either 00 or 00000000 is read.

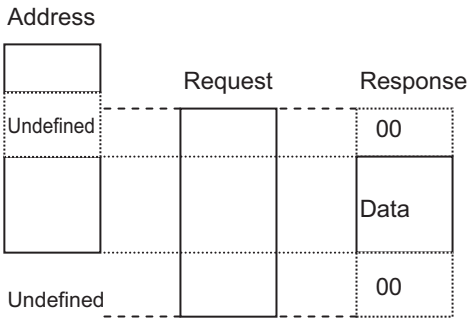
(2) Bit Position

Always "00" because there is no bit access.

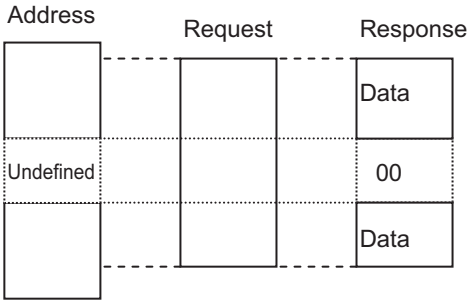
(3) Number of Elements

Number of elements	Processing
0000	The read operation is not performed (read data is not appended to the service response PDU), and processing ends in “normal completion.”
1~128 (KP40G / KP□□L) 1~200 (KP100G)	When the variable type is "4_" The read operation is performed, and processing ends in “normal completion”
1~32 (KP40G / KP□□L) 1~50 (KP100G)	When the variable type is "C_" or "D_" The read operation is performed, and processing ends in “normal completion”

Note 1 If the Read Start Address is outside of the variable area, the returned read data will all be 0, but the specified number of elements will be returned and the processing will end in "normal completion."



2 If the Read Start Address is within the variable area and the Read End Address (Read Start Address + Number of Elements) is beyond the last variable area address, the read operation will be performed as long as the amount of data up to the last variable area address is within the specified range of the number of elements. The read data beyond the end of the variable area will all be set to 0. (See the following example.)



(4) Response Codes

Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
1002	Command too short	The command is too short.	2
1101	Area type error	The variable type is incorrect.	3
110B	Response too long	The number of elements exceeds the maximum.	4
1100	Parameter error	The bit position is not 00.	5
0000	Normal completion	No error.	None

(5) Read Data

0 digits, 0 bytes	When the number of elements in the service request PDU is 0000.
2 digits, 1 byte	When the variable type in the service request PDU is “4_”.
8 digits, 4 bytes	When the variable type in the service request PDU is "C_" or "D_"

Refer to *5-1 Variable Area (Setting Range) List* for data details.

"8 digits, 4 bytes" means that when the internal data is 4 bytes, the communications data is 8 bytes.

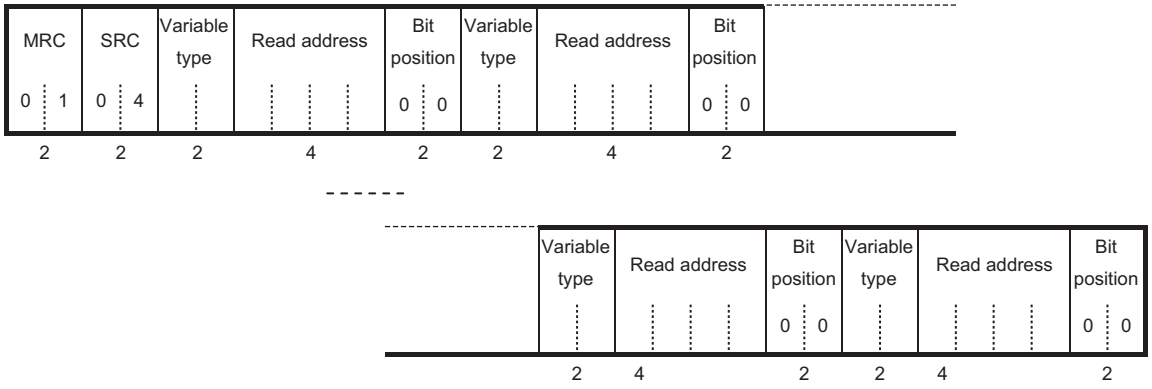
Example:
Communications data: 0x30 + 0x31 + 0x32 + 0x33 + 0x34 + 0x35 + 0x36 + 0x37
(character expression: 01234567)
Internal data: 0x01234567

3-4-2 Composite read from variable area (KP□□L only)

This service reads in order the contents of specified addresses in a variable area.
This command cannot mix variable type C_, variable type 4_, and variable type D_.

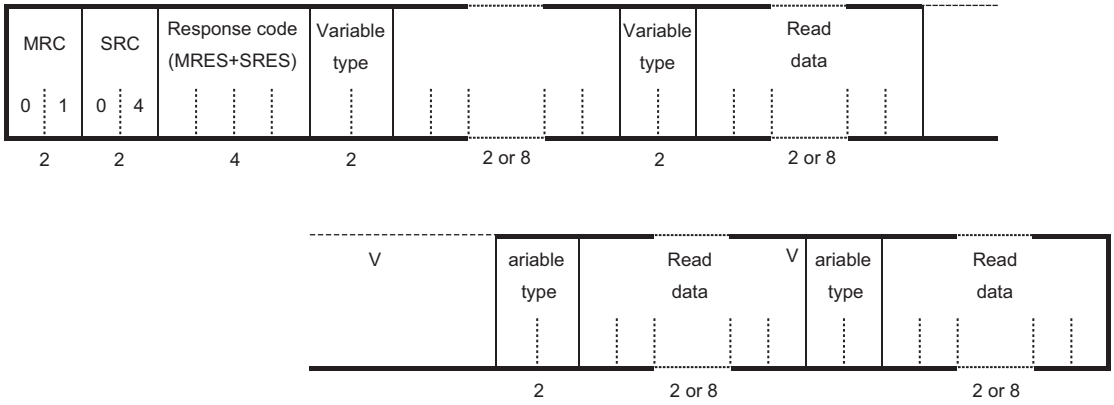
Command

- **Service Request PDU**



Response

- **Service Response PDU**



(1) Variable Type and Read Address

Refer to *5-1 Variable Area (Setting Range) List* for information on all types.

(2) Bit Position

Always "00" because there is no bit access.

(3) Number of Elements

Number of elements	Processing
0000	The read operation is not performed (read data is not appended to the service response PDU), and processing ends in “normal completion.”
1~33	When the variable type is "4_" The read operation is performed, and processing ends in “normal completion”
1~25	When the variable type is "C_" or "D_" The read operation is performed, and processing ends in “normal completion”

(4) Attention at reading variable area

In case that read address is undefined, read data is [00] (4_ : command) or [00000000](C_, D_:command).

(5) Response Codes

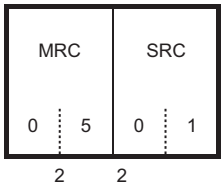
Response code (MRES+SRES)	Error name	Cause	Error priority
1002	Command too short	The command is too short.	3
1101	Area type error	The variable type is incorrect.	1
110B	Response too long	The number of elements exceeds the maximum.	4
1100	Parameter error	The bit position is not 00.	2
0000	Normal completion	No error.	None

3-4-3 Read Controller information

This service reads the Controller's model and version.

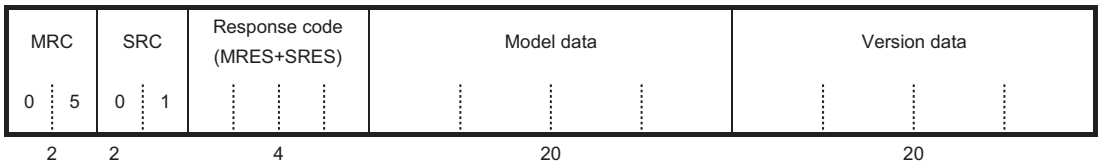
Command

● Service Request PDU



Response

● Service Response PDU



(1) Model data

The model number is returned in 20 bytes of ASCII data. If the data is less than 20 bytes long, the remaining bytes will be padded with spaces (20 hex).

The following table shows the model number format.

Model	Model data
KPxxxx-OD-xx	KPxxxx-OD-xx-xx (Space code)

(2) Version data

The version number is returned in 20 bytes of ASCII data. If the data is less than 20 bytes long, the remaining bytes will be padded with spaces (20 hex).

Version	Version data
V1.00	1.00(Space code)

(3) Response Codes

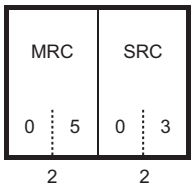
Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
0000	Normal completion	No error.	None

3-4-4 Read Controller Attributes

This service reads the model number and communications buffer size.

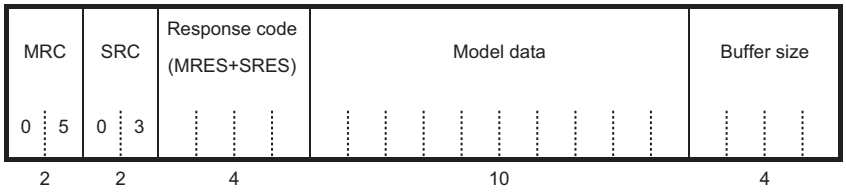
Command

- **Service Request PDU**



Response

- **Service Response PDU**



(1) Model data

The model is returned in 10 bytes of ASCII data. If the data is less than 10 bytes long, the remaining bytes will be padded with spaces (20 hex).

Model	Model data
KPxxxx	KPxxxx(Space code)

(2) Buffer Size

The communications buffer size is expressed in 2-byte hexadecimal and is converted to 4-byte ASCII before being displayed.

Model	Buffer Size
KP40G / KP□□L	273bytes (0111)
KP100G	417bytes (01A1)

(3) Response Codes

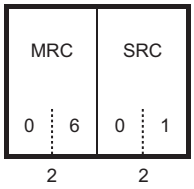
Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
0000	Normal completion	No error.	None

3-4-5 Read Controller Status

This service reads the operating status and error status.

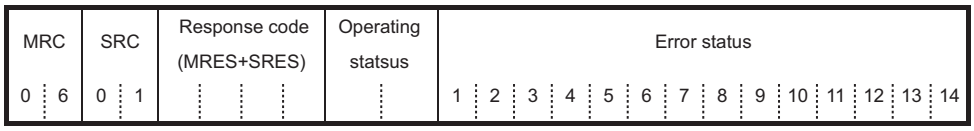
Command

● Service Request PDU



Response

● Service Response PDU



(1) Operating status

Operating status								Description	
MSB (Bit)						LSB (Bit)			
						0	0	1)	[KP100G] Reservation [KP40G / KP□□L] Stop
						0	1		On grid instruction
						1	0		Reservation
						1	1		Reservation
					0			2)	[KP40G] Excluding turning on both Relay3/4 [KP100G / KP□□L] Excluding turning on both Relay4/5/6
					1				[KP40G] Turning on both Relay3/4 [KP100G / KP□□L] Turning on both Relay4/5/6
				0				3)	[KP40G] Excluding turning on both Relay1/2 [KP100G / KP□□L] Excluding turning on both Relay1/2/3
				1					[KP40G] Turning on both Relay1/2 [KP100G / KP□□L] Turning on both Relay1/2/3
			0					4)	Gate Block
			1						Excluding while blocking the gate
		0						5)	[KP40G / KP100G] Reservation [KP□□L] Excluding turning on Relay N
									[KP40G / KP100G] Reservation [KP□□L] Turning on Relay N
0	0							6)	Reservation

1) Instruction status of KP inverter.

2) 3) The grid relay ON/OFF status

In KP40G, 4 relays are built into. It is occupied whether to have turned on both of relays of a side nears the grid (Relay3/4) among these. Similarly it shows whether to have turned on the relay of a side near the inside (Relay1/2).

In KP100G or KP□□L, 6 relays are built into. It is occupied whether to have turned on relays of a side nears the grid (Relay4/5/6) among these. Similarly it shows whether to have turned on the relay of a side near the inside (Relay1/2/3).

4) The state to stop the switching of inverter is called a gate block, and the stopped state or the power generation of the output is shown.
5) It shows whether to have turned on the relay of the Neutral line on KP□□L.

(2) Error status

	1(MSB~LSB)				2			
	1	2	3	4	1	2	3	4
KP40G KP□□L	E1-1 OV	E1-2 UV	E1-3 OF	E1-4 UF	E1-5 Islanding Passive	E1-6 Islanding Active	E1-7 OV instantly	E1-8 UV instantly
KP100G	E1-1 Grid OV	E1-2 Grid UV	E1-3 Grid OF	E1-4 Grid UF	0	E1-6 Islanding active	E1-7:Grid OV instantly	0
	3				4			
	1	2	3	4	1	2	3	4
KP40G KP□□L	E2-1 DC overvoltage	0	E2-3 Ground I fault	E2-4 Insulation resistance fault	E3-1 DC overcurrent	E3-2 AC overcurrent	E3-3 DC current injection	E3-4 Over temperature
KP100G	E2-1 PV over voltage	0	E2-3 Ground I Fault	E2-4 Isolation fault	0	E3-2 Over AC current	E3-3 DC INJ High	E3-4 Over temperature
	5				6			
	1	2	3	4	1	2	3	4
KP40G KP□□L	0	0	0	0	E4-1 Abnormality of comparison of measurement	E4-2 Abnormity of efficiencyc	E4-3 Failure of inverter	E4-4 Abnormal ROM version
KP100G	0	0	0	0	E4-1 Consistent fault	E4-2 DC sensor Fault	0	E4-4 M-S Ver. Fault
	7				8			
	1	2	3	4	1	2	3	4
KP40G	E4-5 Abnormality of power source	E4-6 Abnormal EEPROM Sum value	E4-7 Failure of eeprom	E4-8 Abnormality Device setting	E5-1 Failure of relay	E5-2 Communication error between CPUs	0	E5-4 DC/DC undervoltage
KP□□L								
KP100G	0	0	0	0	0	0	0	E5-4 Low DC bus
	9				10			
	1	2	3	4	1	2	3	4
KP40G	E5-5 Breaking circuit detecting fault current	E5-6 Failure of inverter (Over current)	E5-7 Communication error	E5-8 Breaking of circuit detecting leakage circuit	0	0	0	0
KP□□L	0			0	E5-9 Auto test failure			
KP100G	0	0	0	E5-8 GFCI Failure	E5-9 Auto test failure	0	0	0
	11				12			
	1	2	3	4	1	2	3	4
KP40G KP□□L	0	0	0	0	0	0	0	E1-0 No Utility
KP100G	0	0	0	0	A2-5 Fan Lock	A2-6 Hihg DC bus	0 A2-7 Memory Full <In the future>	E1-0 No Utility
	13				14			
	1	2	3	4	1	2	3	4
KP40G KP□□L	A1-1 Voltage enhancement control	A1-2 MPPT Control stop	A1-3 Synchronous gap generation	A1-4 DC undervoltage	0	0	A1-7 Output current control	0
KP100G	0	0	0	0	0	0	0	A1-9 EEPROM failure

(3) Response Codes

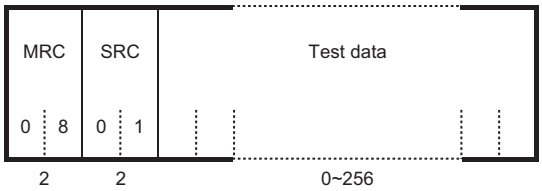
Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
0000	Normal completion	No error.	None

3-4-6 Echoback Test

This service performs an echoback test.

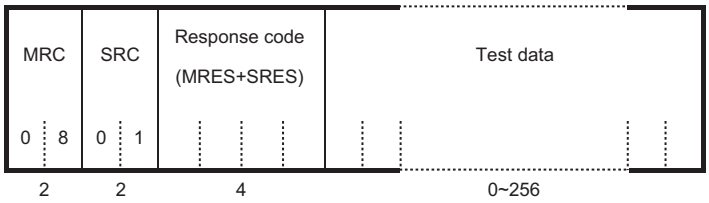
Command

● Service Request PDU



Response

● Service Response PDU



(1) Test Data

Set values for the test data within the ranges 20 to 7E hex in ASCII data.

(2) Response Codes

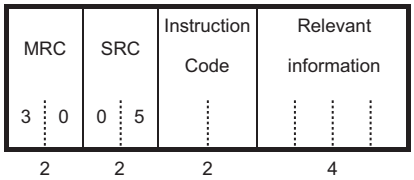
Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
0000	Normal completion	No error.	None

3-4-7 Operation Command

This service performs operation command processing to KP inverter.

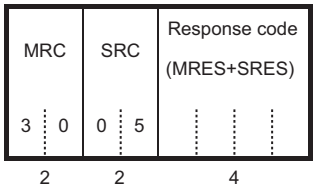
Command

● Service Request PDU



Response

● Service Response PDU



(1) Command code and related information

Command code	Command content	Relatedinformation
02	Initialize Error log	0000: Error history initialization
14	Clear Total Periodic Energy that user set	0000

(2) Response Codes

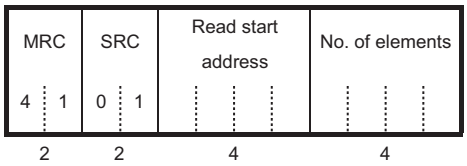
Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
1002	Command too short	The command is too short.	2
1100	Parameter error	Command code and related information are wrong.	3
0000	Normal completion	No error.	None

3-4-8 Read character string area.

This service reads character string area.

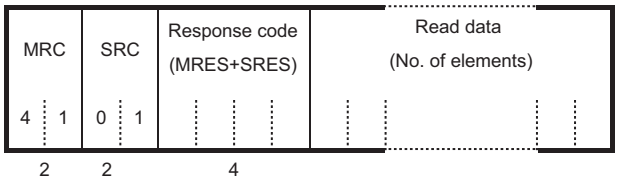
Command

● Service Request PDU



Response

● Service Response PDU



(1) Variable Type and Read Start Address

Refer to *5-1 Variable Area (Setting Range) List* for information on all types.

If data outside the address range is read, read data not added to service response PDU.

(2) Number of Elements

Number of elements	Processing
0000	The read operation is not performed (read data is not appended to the service response PDU), and processing ends in “normal completion.”
0001	The data readout in one character is performed and processing ends in “normal completion.”
0002	The data readout in two character is performed and processing ends in “normal completion.”
:	
0000	The data readout in 15 character is performed and processing ends in “normal completion.”

(3) Response Codes

Response code (MRES+SRES)	Error name	Cause	Error priority
1001	Command too long	The command is too long.	1
1002	Command too short	The command is too short.	2
110B	Response too long	The number of elements exceeds 000F.	3
0000	Normal completion	No error.	None

(4) Read Data

Refer to *5-1 Variable Area (Setting Range) List* for data details.

3-5 Response Code List

Response code (MRES+SRES)	Error name	Cause	Error priority
0000	Normal completion	No error.	None
0401	Unsupported command	The service function for the specified command is not supported.	1
1001	Command too long	The command is too long.	2
1002	Command too short	The command is too short.	3
1101	Area type error	The variable type is incorrect.	4
1003	Number of elements/data number mismatch	The amount of data does not match the number of elements.	5
110B	Response too long	The response exceeds the communications buffer size.	6
1100	Parameter error	• The bit position is not 00. • A value that must be 00 was not set to 00. • Incorrect command code or related information in the operation command. • The write data is out of the setting range.	7

4

MODBUS

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4-1 MODBUS Communications Specifications

Communications Control Method

Programs can be created in the host computer (e.g., a personal computer) to set or monitor parameters in the KP□□L. Therefore the descriptions in this section are from the standpoint of the host computer. For example, "Read/Write" refers to the host computer reading or writing to the inverter.

Communications Specifications

Interface	RS-485
Transmission path connections	Multipoint
Communications	2-wire system half duplex
Baud rate	4800 / 9600 / *19200bps
Synchronization	Start-stopsynchronization
Transmitted code	RTU (Binary code)
Data bit length	8 bits
Stop bit length	*1 bit / 2bits
Error detection	Parity check (*Odd / Even / None) CRC-16 (Cyclical Redundancy Check)
Flow control	None
Retry function	None
Response wait time after command transmitted	3.5Char or more 19200bps : about 2ms or more (11bit/Char) 9600bps : about 4ms or more (11bit/Char)
Waiting time after response	3.5Char or more 19200bps : about 2ms or more (11bit/Char) 9600bps : about 4ms or more (11bit/Char)

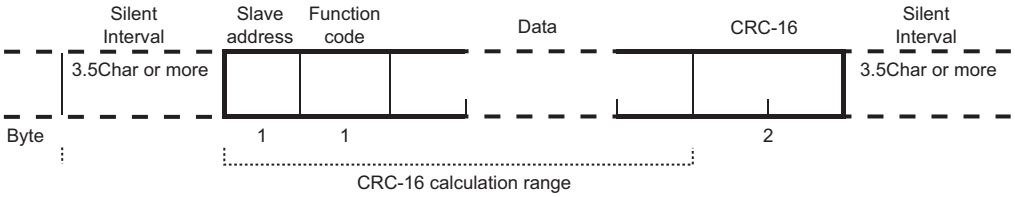
* default

4-2 Frame Formats

Modbus is a communications control method that conforms to the RTU Mode of the Modbus protocol specifications PI-MBUS-300 Rev. J) of Modicon Inc.
The host computer sends a command frame, and the KP inverter sends a response frame based on the content of the command frame. One response frame is sent in response to one command frame.

4-2-1 Command Frame structure

In the following explanation, an "hex" following a numeric value (for example 02 hex) indicates that the value is a hexadecimal number. A number or letters enclosed in quotation marks (for example "00") is an ASCII character.
In RTU Mode, each frame begins and ends with a silent time interval that is at least 3.5 characters long.



	Silent interval at least 3.5 characters long.
Slave address	Specify the node number of the KP inverter between 00 hex and 63 hex (0 to 99). When broadcasting to all nodes, specify 00 hex. Responses are not returned for broadcasts.
Function code	The function code specifies the command from the host computer. The code is set in hexadecimal and is 1 byte long. For more information, refer to *5-1 Variable Area (Setting Range) List*
Data	The text of command based on the function code. Specifies variable addresses and the values for set values in hexadecimal.
CRC-16	Cyclical Redundancy Check These two bytes store check code calculated from the slave address to the end of the data in hexadecimal.
	Silent interval at least 3.5 characters long.

Note The maximum size of a MODBUS RTU frame is 256 bytes.

Example of CRC-16 Calculation

A message is processed 1 byte at a time in a 16-bit processing register called the CRC register.

1 An initial value of FFFF hex is set in the CRC register.

2 An XOR is taken of the contents of the CRC register and the 1st byte of the message, and the result is returned to the CRC register.

3 The contents of the CRC register is shifted 1 bit to the right, and 0 is placed in the MSB.

4 If the bit shifted from the LSB is 0, step 3 is repeated (i.e., the contents of the register is shifted 1 more bit).
If the bit shifted from the LSB is 1, an XOR is taken of the contents of the CRC register and A001 hex, and the result is returned to the CRC register.

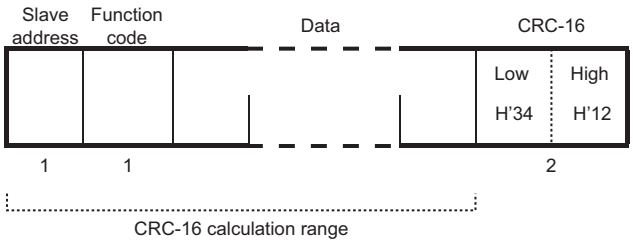
5 Steps 3 and 4 are repeated until the contents of the register have been shifted 8 bits to the right.

6 If the end of the message has not been reached, an XOR is taken of the next byte of the CRC register and the message, the result is returned to the CRC register, and the procedure is repeated from step (3).

7 The result (the value in the CRC register) is placed in the lower byte of the message.

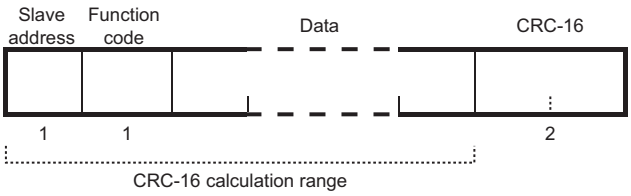
Example of Appending the Result

If the calculated CRC value is 1234 hex, this is appended as follows to the command frame:

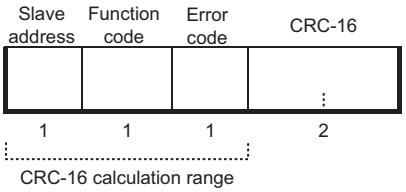


4-2-2 Response Frame Structure

Normal Response Frames



Error Response Frames



Slave address	The nodenumber that was specified in the command frame is returned here. This is the node number of the responding KP inverter.
Function code	The function code that was received is returned here. In an error response frame, 80 hex is added to the value to indicate that this is an error response. Example: Received function code = 03 hex Function code in error response frame = 83 hex
Error code	An end code that indicates the error.
CRC-16	Cyclical Redundancy Check These two bytes are a check code calculated from the slave address through the end of the data in hexadecimal.

No Response

In the following cases, the received command is not processed and a response is not returned. A timeout will occur at the host device.

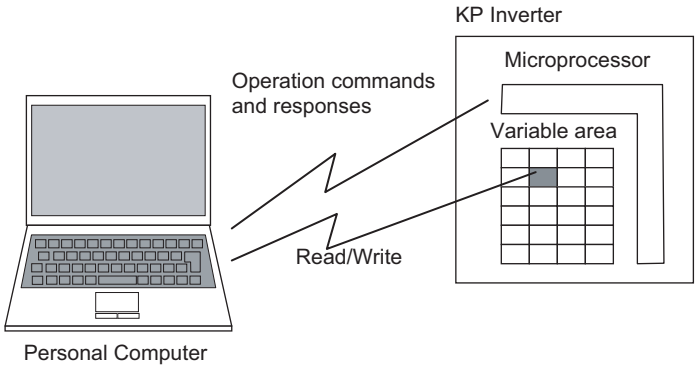
- The slave address in the received command is different from the communications unit number set in the KP inverter.
- A parity error, framing error, or overrun error occurred due to a transfer error or other error.
- A CRC-16 code error occurred in the received command frame.
- A time interval greater that 3.5 characters occurred between data while receiving a command frame. In the following case, the command is processed, but a response is not returned.
- Broadcast transmission (Slave address: 00hex)

4-3 Function Codes

Function code	Name	Description
03 (03 hex)	Multiple Read from Variable Area	Reads from a variable area. Multiple variables that are consecutive can be read.
06 (06 hex)	Single Write to Variable Area	Writes to a variable area or an operation command. Broadcasting is possible
08 (08 hex)	Echoback Test	Performs an echoback test.

4-4 Variable Areas

The area used for data exchange when communicating with the KP inverter is called the "variable area." The current values are read and various setting data are read and written using the variable area of the KP inverter.



4-4-1 Addresses

Refer to *5-1 Variable Area (Setting Range) List* for parameter addresses. Parameters with the following variable types can be used with the Modbus protocol:

4-4-2 Number of Elements

The number of elements is expressed in 2-byte hexadecimal format.
The range for specifying the number of elements differs for each command.
Refer to *5-1 Variable Area (Setting Range) List*.

4-4-3 Communications Data

Setting (monitor) value	Communications data (See note.)	Negative values	Decimal point
Hexadecimal	2 bytes	2's complement	The decimal point is removed and the result is converted to hexadecimal. Example: 105.0 → 1050 → 041A

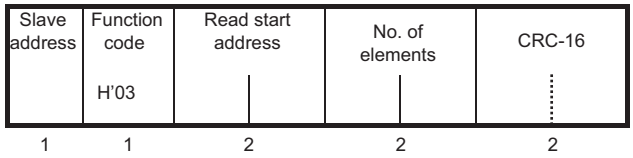
Note Refer to *5-1 Variable Area (Setting Range) List*.

4-5 Detailed Description of Services

4-5-1 Multiple Read from Variable Area

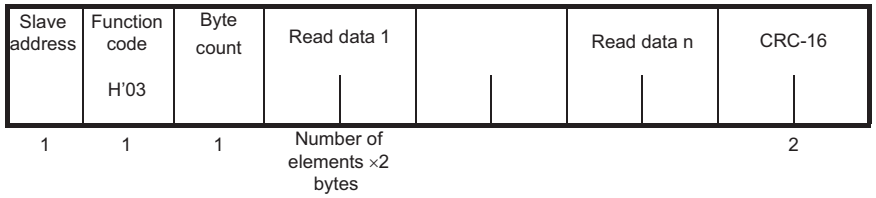
This service reads data from the variable area.

Command

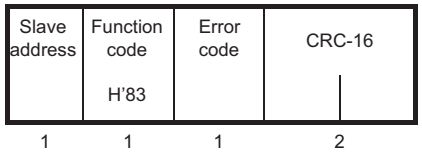


Response

[Normal response]



[Abnormal response]



(1) Read Start Address

Refer to*5-1 Variable Area (Setting Range) List*.

Same data as Read Controller information (*3-4-3 Read Controller information*) and Read Controller Status (*3-4-5 Read Controller Status*) in Compoway/F can be read by this service.

Refer to *5-1 Variable Area (Setting Range) List* in detail to read Controller information and Controller status.

(2) No. of Elements

Specify the number of elements to read. The specification range is from 0001 to 007D hex (1 to 125 elements).

(3) Byte Count

The number of bytes of data that was read is returned.

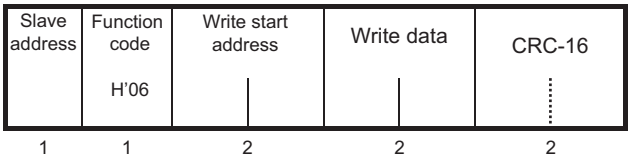
(4) Response Codes

Function code	Error code	Error name	Cause
83 hex	02 hex	Variable address error	The read start address is not correct.
	03 hex	Variable data error	• The command is too long. • The command is not long enough. • The number of elements has exceeded the maximum limit.
03 hex	--	Normal completion	The service was processed normally.

4-5-2 Single Write to Variable Area

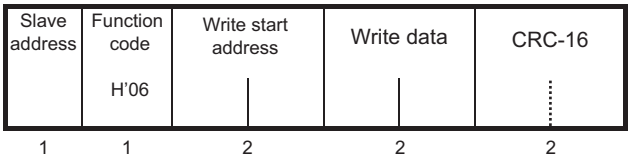
This service either writes data to the variable area or executes the operation commands

Command

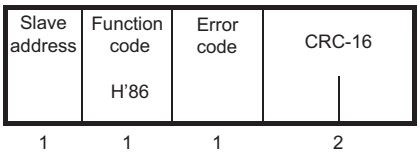


Response

[Normal response]



[Abnormal response]



(1) Write Start Address

Set the write start address to FFFF hex when executing an operation command.

When writing to the variable area, refer to *5-1 Variable Area (Setting Range) List*.

(2) Write Data

When executing an operation command, place the write data as follows.

Upper bite: command code

Lower bite: related information

Command content	Command code (upper bite)	Related information (lower bite)
Initialize Error log	0x02	0x00
Clear Total Periodic Energy that user set	0x14	0x00

(3) Response Codes

Function code	Error code	Error name	Cause
86 hex	02 hex	Variable address error	The write start address is not correct.
	03 hex	Variable data error	• The command is too long. • The command is not long enough.
06 hex	--	Normal completion	The service was processed normally.

5

Communications Data

5-1 Variable Area (Setting Range) List 5-2

5-1 Variable Area (Setting Range) List

The following table lists the variable areas. Items expressed in hexadecimal in the “Content explanation” column are the setting range for CompoWay/F or MODBUS communications. The values in parentheses are the actual setting range.

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
47 Set Value for setting country Read/Write	0000	0A00 (upper)	Country setting	0x00: [GER] Germany 0x01: [FRA] France 0x02: [GRE] Greece 0x03: [CZE] Czech Republic 0x04: [DEN] Denmark 0x05: [TUR] Turkey 0x06: [RSA] Republic of South Africa 0x07: [ESP] Spain 0x08: [POR] Portugal 0x09: [ITA] Italy	0x02: Itary 0x03: Spain 0x04: Korea	KP40G-OD-1: 0x00: none 0x01: Netherlands 0x02: Italy 0x03: Spain 0x04-FF: none KP40G-OD-2: 0x00: none 0x01: Germany(with ENS) 0x02: Germany(without ENS) 0x03: Austria(with ENS) 0x04: Austria(without ENS) 0x05: none 0x06: Switzerland(without ENS) 0x07-FF: reserved
	0001	0A00 (lower)	Reserved	Reserved	Reserved	Reserved
48 Set each model Read Only	0000	0B00 (upper)	The number of DC input	03 : 3 inputs 04 : 4 inputs	01 : 1 input 02 : 2 inputs 03 : 3 inputs 0x: x inpus	---
	0001	0B00 (Lower)	Reserved	Reserved	Reserved	---
C1 Protective Relay Read/Write	0000	5500	Setting value of overvoltage (OV)	00000000 to 000005DC hex (0 to 300.0V unit is 0.2V)	00000000 to 000005DC hex (0 to 300.0V unit is 0.2V)	00000000 to 000005DC hex (0 to 300.0V unit is 0.2V)
		5501				
	0001	5502	Setting value of undervoltage (UV)	00000000 to 000005DC hex (0 to 300.0V unit is 0.2V)	00000000 to 000005DC hex (0 to 300.0V unit is 0.2V)	00000000 to 000005DC hex (0 to 300.0V unit is 0.2V)
		5503				
	0002	5504	Setting value of overfrequency (OF)	50Hz:00001392 to 00001964 hex (50.10 to 65.00Hz)	50Hz:000013BA to 00001450 hex (50.50 to 52.00Hz) 60Hz:000017A2 to 00001838 hex (60.50Hz to 62.00Hz)	50Hz:000013BA to 00001450 hex (50.50 to 52.00Hz) 60Hz:000017A2 to 00001838 hex (60.50Hz to 62.00Hz)
		5505				
	0003	5506	Setting value of underfrequency (UF)	50Hz:000012F2 to 00001356 hex (48.50 to 49.50Hz)	50Hz:000012C0 to 00001356 hex (48.00 to 49.5Hz) 60Hz:000016A8 to 0000173E hex (58.00 to 59.50Hz)	50Hz:000012C0 to 00001356 hex (48.00 to 49.5Hz) 60Hz:000016A8 to 0000173E hex (58.00 to 59.50Hz)
		5507				

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
C2 Standard Measurement Read Only	0000	5A00	PV-input voltage[1] (DC voltage[1])	00000000 to 0000FFFF hex (0.0 to 6553.5V)	00000000 to 0000FFFF hex (0.0 to 6553.5V)	00000000 to 0000FFFF hex (0.0 to 6553.5V)
		5A01				
	0001	5A02	Current from PV-panels[1] (Direct current[1])	FFFF8000 to 00007FFF hex (-327.68 to 327.67A)	00000000 to 0000FFFF hex (0.00 to 655.35A)	FFFF8001 to 00007FFF hex (-327.67 to 327.67A)
		5A03				
	0002	5A04	PV-input power[1] (DC power[1])	FFFF0000 to 0000FFFF hex (-65536 to 65535W)	00000000 to 0000FFFF hex (0 to 65535W)	FFFF0001 to 0000FFFF hex (-65535 to 65535W)
		5A05				
	0004	5A08	Utility voltage [L1]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)
		5A09				
	0006	5A0C	Grid frequency	00000000 to 0000FFFF hex (0 to 655.35Hz)	00000000 to 0000FFFF hex (0 to 655.35Hz)	00000000 to 0000FFFF hex (0 to 655.35Hz)
		5A0D				
	0007	5A0E	Output voltage[L1]	00000000 to 0000FFFF hex (0 to 6553.5V)	00000000 to 0000FFFF hex (0 to 6553.5V)	---
		5A0F				
	0008	5A10	Output current[L1]	00000000 to 0000FFFF hex (0 to 655.35A)	00000000 to 0000FFFF hex (0 to 655.35A)	00000000 to 0000FFFF hex (0 to 655.35A)
		5A11				
	0009	5A12	Output power (without software filter)	FFFF8000-00007FFF hex (-32768 to 32767W)	00000000 to FFFFFFFF hex (0 to 4294967295W)	---
		5A13				
	000A	5A14	Output power for display (with software filter)	FFFF8000-00007FFF hex (-32768 to 32767W)	00000000 to FFFFFFFF hex (0 to 4294967295W)	FFFF0001-0000FFFF hex (-65535 to 65535W)
		5A15				
	0010	5A20	TNS : Total number start-up's	00000000 to 0000FFFF hex (0 to 65535times)	00000000 to FFFFFFFF hex (0 to 4294967295times)	00000000 to 0000FFFF hex (0 to 65535times)
		5A21				
	0100	5C00	Recovery time	80000000 to 7FFFFFFF hex (-214748364.8 to 214748364.7s)	00000000 to 0000FFFF hex (0 to 6553.5s)	---
		5C01				

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
C3 Standard instruction data Read Only	0000	6000	Total enegy after installing the inverter (Amount of operation)	00000000 to 3B9AC9FF hex (0 to 999999999W•h)	00000000 to FFFFFFFF hex (0 to 4294967295W•h)	00000000 to 3B9AC9FF hex (0 to 999999999W•h)
		6001				
	0001	6002	The amount of energy for period user set (the amount of user power)	00000000 to 3B9AC9FF hex (0 to 999999999W•h)	00000000 to FFFFFFFF hex (0 to 4294967295W•h)	00000000 to 3B9AC9FF hex (0 to 999999999W•h)
		6003				
	0002	6004	Total operating hours	00000000 to FFFFFFFF hex (0 to 4294967295s)	00000000 to FFFFFFFF hex (0 to 4294967295s)	00000000 to FFFFFFFF hex (0 to 4294967295s)
		6005				
C8 Three Phase Measurement Read Only	0002	7A04	Total PV-input power	FFFF0000 to 0000FFFF hex (-65536 to 65535W)	00000000 to 0000FFFF hex (0 to 65535W)	---
		7A05				
	0004	7A08	Utility voltage [L1]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	---
		7A09				
	0005	7A0A	Utility voltage [L2]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	---
		7A0B				
	0006	7A0C	Utility voltage [L3]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	---
		7A0D				
	0007	7A0E	Grid frequency	00000000 to 0000FFFF hex (0 to 655.35Hz)	00000000 to 0000FFFF hex (0 to 655.35Hz)	---
		7A0F				
	0008	7A10	Output voltage[L1]	00000000 to 0000FFFF hex (0 to 6553.5V unit is 0.1V)	00000000 to 0000FFFF hex (0 to 6553.5V unit is 0.1V)	---
		7A11				
	0009	7A12	Output voltage[L2]	00000000 to 0000FFFF hex (0 to 6553.5V unit is 0.1V)	00000000 to 0000FFFF hex (0 to 6553.5V unit is 0.1V)	---
		7A13				
	000A	7A14	Output voltage[L3]	00000000 to 0000FFFF hex (0 to 6553.5V unit is 0.1V)	00000000 to 0000FFFF hex (0 to 6553.5V unit is 0.1V)	---
		7A15				
	000B	7A16	Output current[L1]	00000000 to 0000FFFF hex (0 to 655.35A)	00000000 to 0000FFFF hex (0 to 655.35A)	---
		7A17				
	000C	7A18	Output current[L2]	00000000 to 0000FFFF hex (0 to 655.35A)	00000000 to 0000FFFF hex (0 to 655.35A)	---
		7A19				
	000D	7A1A	Output current[L3]	00000000 to 0000FFFF hex (0 to 655.35A)	00000000 to 0000FFFF hex (0 to 655.35A)	---
		7A1B				
	000E	7A1C	Output power (without software filter)	FFFF8000-00007FFF hex (-32768 to 32767W)	00000000 to FFFFFFFF hex (0 to 4294967295W)	---
		7A1D				
	000F	7A1E	Output power for display (with software filter)	FFFF8000-00007FFF hex (-32768 to 32767W)	00000000 to FFFFFFFF hex (0 to 4294967295W)	---
		7A1F				

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
C8 Three Phase Measurement Read Only	0015	7A2A	Utility voltage [L1-L2]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	---
		7A2B				
	0016	7A2C	Utility voltage [L2-L3]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	---
		7A2D				
	0017	7A2E	Utility voltage [L3-L1]	00000000 to 0000FFFF hex (0 to 13107V unit is 0.2V)	00000000 to 00007FFF hex (0 to 6553.5V unit is 0.2V)	---
		7A2F				
	0100	7C00	PV-input voltage[1] (DC voltage[1])	00000000 to 0000FFFF hex (0.0 to 6553.5V)	00000000 to 0000FFFF hex (0.0 to 6553.5V)	---
		7C01				
	0101	7C02	Current from PV-panels[1] (Direct current[1])	00000000 to 0000FFFF hex (0.00 to 655.35A)	00000000 to 0000FFFF hex (0.00 to 655.35A)	---
		7C03				
	0102	7C04	PV-input power[1] (DC power[1])	FFFF0000 to 0000FFFF hex (-65536W to 65535W)	00000000 to 0000FFFF hex (0 to 65535W)	---
		7C05				
	0200	7E00	PV-input voltage[2] (DC voltage[2])	00000000 to 0000FFFF hex (0.0 to 6553.5V)	00000000 to 0000FFFF hex (0.0 to 6553.5V)	---
		7E01				
	0201	7E02	Current from PV-panels[2] (Direct current[2])	00000000 to 0000FFFF hex (0.00 to 655.35A)	00000000 to 0000FFFF hex (0.00 to 655.35A)	---
		7E03				
	0202	7E04	PV-input power[2] (DC power[2])	FFFF0000 to 0000FFFF hex (-65536W to 65535W)	00000000 to 0000FFFF hex (0 to 65535W)	---
		7E05				
	0300	8000	PV-input voltage[3] (DC voltage[3])	00000000 to 0000FFFF hex (0.0 to 6553.5V)	00000000 to 0000FFFF hex (0.0 to 6553.5V)	---
		8001				
	0301	8002	Current from PV-panels[3] (Direct current[3])	00000000 to 0000FFFF hex (0.00 to 655.35A)	00000000 to 0000FFFF hex (0.00 to 655.35A)	---
		8003				
	0302	8004	PV-input power[3] (DC power[3])	FFFF0000 to 0000FFFF hex (-65536W to 65535W)	00000000 to 0000FFFF hex (0 to 65535W)	---
		8005				
	0400	8200	PV-input voltage[3] (DC voltage[3])	00000000 to 0000FFFF hex (0.0 to 6553.5V)	00000000 to 0000FFFF hex (0.0 to 6553.5V)	---
		8201				
	0401	8202	Current from PV-panels[3] (Direct current[3])	00000000 to 0000FFFF hex (0.00 to 655.35A)	00000000 to 0000FFFF hex (0.00 to 655.35A)	---
		8203				
	0402	8204	PV-input power[3] (DC power[3])	FFFF0000 to 0000FFFF hex (-65536W to 65535W)	00000000 to 0000FFFF hex (0 to 65535W)	---
		8205				

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
CA Data for ENS Read only	0004	9508	Riso (Insulatio Resistance)	00000000 to 0000FFFF hex (0 to 6553.5kohm unit is 0.1kohm)	00000000 to 0000FFFF hex (0 to 6553.5kohm unit is 0.1kohm)	00000000 to 0000FFFF hex (0 to 6553.5kohm unit is 0.1kohm)
		9509				
	0007	950E	Zac(Line Impedance)	---	---	00000000-00000CCD hex (0 to 32.77ohm unit is 0.01ohm)
		950F				
D0 Error logging Read Only	0000	C000-C003	Error messages memory Latest error logging	Four high rank bytes are 0000 Four subordinate position bytes are abnormal history datas. (example) When an abnormal history data is "E4-4" "0000E4-4"	Four high rank bytes are 0000 Four subordinate position bytes are abnormal history datas. (example) When an abnormal history data is "E4-4" "0000E4-4"	Four high rank bytes are 0000 Four subordinate position bytes are abnormal history datas. (example) When an abnormal history data is "E4-4" "0000E4-4"
	0001	C004-C007	The previous error log from 1 the latest			
	0002	C008-C00B	The previous error log from 2 the latest			
	:	:	:			
	0030	C0C0-C0C3	The previous error log from 48 the latest			
	0031	C0C4-C0C7	The previous error log from 49 the latest			
Character string data Read Only	0000	Not Supported	Serial number	Serial number 16byte	Serial number 16byte	Serial number 16byte
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			
			Serial number			

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
Modbus read only	Not Supported	FFE0	For read controller information Data is same as Model data (20bytes) by Controller information in Compoway/F (MRC="05", SRC="01")	Model Name 20byte	---	---
		FFE1				
		FFE2				
		FFE3				
		FFE4				
		FFE5				
		FFE6				
		FFE7				
		FFE8				
		FFE9				
		FFEA	For read controller information Data is same as Version data (20bytes) by Controller information in Compoway/F (MRC="05", SRC="01")	Inverter's Firmware Version 20byte	---	---
		FFEB				
		FFEC				
		FFED				
		FFEE				
		FFEF				
		FFF0				
		FFF1				
		FFF2				
		FFF3				

Address			Variable identifier	Model Name		
Compoway/F		Modbus		KP□□L (Compoway/F & Modbus)	KP100G (Compoway/F)	KP40G (Compoway/F)
Type Code	Address					
Modbus read only	Not Supported	FFFB	For read controller status Data is same as status of drive and error status (total 16bytes) by Controller status in Compoway/F (MRC="06", SRC="01")	Operating status & Error status(1-2)	---	---
		FFFC		Error status(3-6)		
		FFFD		Error status(7-10)		
		FFFE		Error status(11-14)		
Modbus write only	Not Supported	FFFF	For operation command refer Modbus command	command code(Upper)	---	---
				relevant information(lower)		